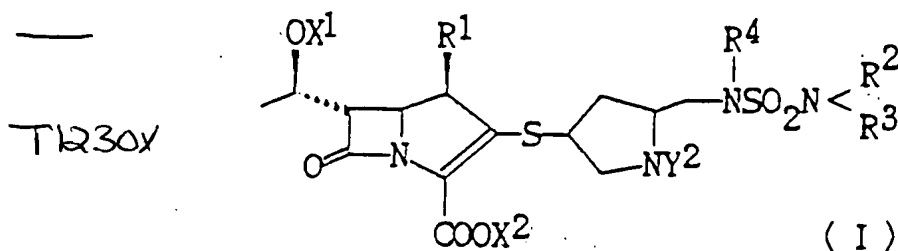


CM What is claimed is:

1. A pyrrolidylthiocarbapenem derivative represented by Formula I:



a 5 P1 wherein R<sup>1</sup> is <sup>hydrogen</sup> or lower alkyl; R<sup>2</sup>, R<sup>3</sup> and R<sup>4</sup> are hydrogen, lower alkyl which can be substituted, or an amino protecting group independently, or R<sup>2</sup> and R<sup>3</sup> together with a nitrogen atom to which R<sup>2</sup> and R<sup>3</sup> are bonded form a saturated or unsaturated cyclic group, or  
10 R<sup>2</sup> and R<sup>4</sup>, or R<sup>3</sup> and R<sup>4</sup> together with two nitrogen atoms and one sulfur atom in the sulfamide group form a saturated or unsaturated cyclic group; each cyclic group can further include at least one atom selected from the group consisting of oxygen, sulfur and nitrogen, and  
15 each cyclic group can be substituted; X<sup>1</sup> is hydrogen or a hydroxy protecting group; X<sup>2</sup> is hydrogen, a carboxy protecting group, an ammonio group, an alkali metal or an alkaline-earth metal; and Y<sup>2</sup> is hydrogen or an amino protecting group.

20

2. A pyrrolidylthiocarbapenem derivative according to claim 1, wherein R<sup>1</sup> is methyl.

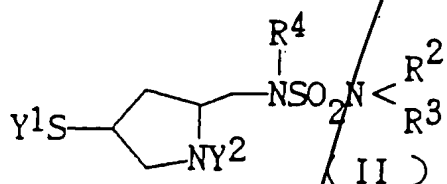
25

3. A pyrrolidylthiocarbapenem derivative according to claim 2, wherein R<sup>4</sup> is hydrogen.

4. A pyrrolidylthiocarbapenem derivative according to claim 3, wherein  $X^1$  and  $Y^2$  are hydrogens and  $X^2$  is hydrogen or alkali metal.
- 5 5. A pyrrolidylthiocarbapenem derivative according to claim 4, wherein  $R^2$  and  $R^3$  are hydrogens;  $R^2$  is methyl and  $R^3$  are hydrogen; both  $R^2$  and  $R^3$  are methyl; or  $R^2$  is 2-hydroxyethyl, and  $R^3$  are hydrogen.
- 10 6. A pyrrolidylthiocarbapenem derivative according to claim 2, wherein  $R^3$  is hydrogen, and  $R^2$  and  $R^4$  are  
13 bonded to each other to form  $-CH_2-CH_2-$ .
- 15 7. A pyrrolidylthiocarbapenem derivative according to claim 2, wherein  $R^3$  is hydrogen, and  $R^2$  and  $R^4$  are  
13 bonded to each other to form  $-CH_2-CH_2-CH_2-$ .
- 20 8. A pyrrolidylthiocarbapenem derivative according to claim 1, wherein at least one group selected from the group consisting of  $R^2$ ,  $R^3$ ,  $R^4$  and  $Y^2$  is selected from the group consisting of t-butyloxy carbonyl, allyloxy-carbonyl, p-nitrobenzyloxycarbonyl, p-methoxybenzyl-oxycarbonyl and diazo.
- 25 9. A pyrrolidylthiocarbapenem derivative according to claim 1, wherein  $X^1$  is selected from the group consist-  
ing of hydrogen, trimethylsilyl, triethylsilyl and t-butoxydimethylsilyl.
- 30 10. A pyrrolidylthiocarbapenem derivative according to claim 1, wherein  $X^2$  is selected from the group consist-  
ing of hydrogen, sodium, potassium, t-butyl, allyl, p-nitrobenzyl, p-methoxybenzyl and diphenylmethyl.
- f

11. A pyrrolidylthiocarbapenam derivative according to claim 1, wherein the pyrrolidine ring in Formula I has a configuration of (3S,5S).

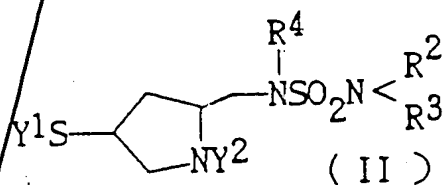
5 12. A pyrrolidine derivative represented by Formula II:



10  
N  
P  
15  
K  
wherein R<sup>2</sup>, R<sup>3</sup> and R<sup>4</sup> are hydrogen, lower alkyl which can be substituted, or an amino protecting group independently, or R<sup>2</sup> and R<sup>3</sup> together with a nitrogen atom to which R<sup>2</sup> and R<sup>3</sup> are bonded form a saturated or unsaturated cyclic group, or R<sup>2</sup> and R<sup>4</sup>, or R<sup>3</sup> and R<sup>4</sup> together with two nitrogen atoms and one sulfur atom in the sulfamide group form a saturated or unsaturated cyclic group; each cyclic group can further include at least one atom selected from the group consisting of oxygen, sulfur and nitrogen, and each cyclic group can be substituted; Y<sup>1</sup> is hydrogen or a mercapto protecting group; and Y<sup>2</sup> is hydrogen or an amino protecting group.

20 13. A pyrrolidine derivative according to claim 12, wherein R<sup>4</sup> is hydrogen.

14. A method for producing a pyrrolidine derivative represented by Formula II:



wherein  $R^2$ ,  $R^3$  and  $R^4$  are hydrogen, lower alkyl which can be substituted, or an amino protecting group independently, or  $R^2$  and  $R^3$  together with a nitrogen atom to which  $R^2$  and  $R^3$  are bonded form a saturated or unsaturated cyclic group, or  $R^2$  and  $R^4$ , or  $R^3$  and  $R^4$  together with two nitrogen atoms and one sulfur atom in the sulfamide group form a saturated or unsaturated cyclic group; each cyclic group can further include at least one atom selected from the group consisting of oxygen, sulfur and nitrogen, and each cyclic group can be substituted;  $Y^1$  is hydrogen or a mercapto protecting group; and  $Y^2$  is hydrogen or an amino protecting group;

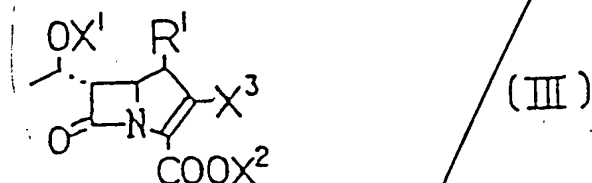
the method comprising the steps of:  
converting a hydroxy group at the 4-position of a 4-hydroxypyrrolidine-2-carboxylic acid derivative into a mercapto group;  
converting a carboxy group at the 2-position into a hydroxymethyl group;  
converting a hydroxy group in the hydroxymethyl group into an amino group; and  
converting the amino group into a sulfamido group.

15. A method according to claim 14, wherein  $R^4$  is hydrogen.

16. A method for producing a pyrrolidylthiocarbapenem derivative comprising the step of:

allowing a carbapenem derivative to react with the pyrrolidine derivative of claim 12 to obtain the pyrrolidylthiocarbapenem derivative of claim 1;

the carbapenem derivative being represented by Formula III:

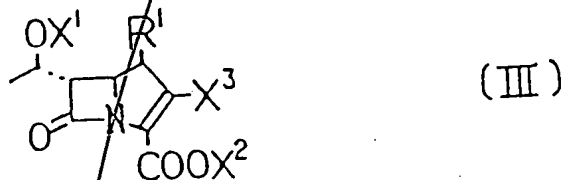


wherein R<sup>1</sup> is hydrogen or lower alkyl; x<sup>1</sup> is hydrogen or a hydroxy protecting group; x<sup>2</sup> is hydrogen, a carboxy protecting group, an ammonio group, an alkali metal or an alkaline-earth metal; and x<sup>3</sup> is a leaving group.

17. A method for producing a pyrrolidylthiocarbapenem derivative comprising the step of:

allowing a carbapenem derivative to react with the pyrrolidine derivative according to claim 13 to obtain the pyrrolidylthiocarbapenem derivative of claim 2;

the carbapenem derivative being represented by Formula III:



wherein R<sup>1</sup> is hydrogen or lower alkyl; x<sup>1</sup> is hydrogen or a hydroxy protecting group; x<sup>2</sup> is hydrogen, a carboxy protecting group, an ammonio group, an alkali

NP  
NK

metal or an alkaline-earth metal; and  $x^3$  is a leaving group.

~~12~~  
18. An antibacterial agent comprising an effective  
5 amount of the pyrrolidylthiocarbapenem derivative of  
claim 1 as an active ingredient.

~~13~~  
19. An antibacterial agent comprising an effective  
10 amount of the pyrrolidylthiocarbapenem derivative of  
claim 4 as an active ingredient.

~~14~~  
20. An antibacterial agent comprising an effective  
amount of the pyrrolidylthiocarbapenem derivative of  
claim 5 as an active ingredient.

~~15~~  
21. An antibacterial agent comprising an effective  
15 amount of the pyrrolidylthiocarbapenem derivative of  
claim 11 as an active ingredient.

~~16~~  
22. A method for inhibiting growth of bacteria sensi-  
20 tive to the pyrrolidylthiocarbapenem derivative of  
claim 1 by allowing the sensitive bacterium to be in  
contact with an effective amount of the pyrrolidylthio-  
carbapenem derivative.

---